An NGQD Based Diagnostic Tool for Pancreatic Cancer

Background

Pancreatic cancer remains difficult to detect at early stages which contributes to a poor five-year-survival rate. Therefore, early detection approaches based on novel technologies should be explored to address this critical health issue. Nanomaterials have recently emerged as frontrunners for diagnostic applications due to their small size in the 1-100 nm range, which facilitates one-on-one interactions with a variety of biomolecules like oligonucleotides and makes them suitable for a plethora of detection and delivery applications. In this work, the presence of specific pancreatic cancer miRNA (pre-miR-132) is detected utilizing the fluorescence properties of highly biocompatible nitrogen-doped graphene quantum dots (NGQDs).

Methods

NGQDs were synthesized from Glucosamine HCl and deionized H_2O. Cuvettes were filled with a mixture of bait ssDNA (13.7μM) and NGQDs (0.5 mg/ml) in deionized H2O that was vortexed for 5s before adding target strands. Samples were again vortexed for 5s and incubated at 4 ºC for 2hrs before excitation at 400 nm with an emission wavelength measured from 420 nm to 780 nm using a spectrofluorometer. Data analysis was performed using Origin software.

Results

From the Zeta potential measurements, this platform is comprised of positively charged (1.14 ± 0.36 mV) NGQDs binding with negatively charged (-22.4 ± 6.00 mV) ssDNA electrostatically and/or via $\pi - \pi$ stacking to form an NGQDs/ssDNA complex with an estimated size of 20 nm verified with TEM. Observing variations in fluorescence spectra of NGQDs/ssDNA complexes allows for the distinguishing of single-stranded and double-stranded DNA, as well as specific single-stranded DNA sequences due to bait-target complementarity. Furthermore, this enables detection of the loop of pre-miRNA of interest and can identify target miRNA from random controls with sensitivity in the nanomolar range.

Conclusions

This approach allows for pancreatic cancer-specific miRNA sensing to facilitate pancreatic cancer detection at the early stages. Such early diagnosis is ultimately aimed to increase cancer patient survival rates.

Note: Conclusions and results are not currently finalized. To be completed in the next few weeks.